

Claims

1. Apparatus for charging or discharging a piezoelectric element (1 and/or 11₁, 12₁, ... 1n₁), characterized in that a current is regulated as a function of a time characteristic and an event characteristic to achieve an effective low average current.

10 2. Apparatus for charging or discharging a piezoelectric element (1 and/or 11₁, 12₁, ... 1n₁) of a fuel injection system, characterized in that a current of the fuel injection system is regulated as a function of a time characteristic and an event characteristic to achieve an effective low average current.

15 3. Apparatus as according to claims 1 or 2, characterized in that the current is regulated by switching a charge or discharge switch (3, 5) as the function of the time characteristic and the event characteristic to achieve the effective low average current.

20 4. Apparatus as according to any of the preceding claims, characterized in that when the current is at a level below a predefined lower threshold, the charge switch remains open for a predefined time interval to allow the current to exhibit a gap.

25 5. Apparatus as according to any of the preceding claims, characterized in that a charge switch (3) or a discharge switch (5) of the apparatus is switched from an OFF position to an ON position or from the ON position to an OFF position, respectively to allow or stop charging or

discharging when an absolute value of the current is respectively equal to or greater than or less than the event characteristic which is a predefined limit threshold current.

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6. Apparatus as according to any of the preceding claims, characterized in that a charge or discharge switch (3, 5) of the apparatus is switched from the OFF position to the ON position to allow charging or discharging at a predefined time of the time characteristic after the absolute value of the current is equal to or less than the event characteristic which is a predefined lower limit threshold current.

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15 7. Apparatus as according to any of the preceding claims, characterized in that a square-wave signal of a certain frequency is used to switch a charge or discharge switch (3, 5) from an OFF position to an ON position to allow charging or discharging.

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25 8. Apparatus as according to any of the preceding claims, characterized in that the charge or discharge switch (3, 5) is switched from the ON position to the OFF position when the absolute value of the current is equal to or greater than the event characteristic which is a predefined limit threshold current.

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30 9. Apparatus as according to any of the preceding claims, characterized in that a desired average current is achieved by varying the time characteristic and the event characteristic.

10. Apparatus as according to any of the preceding claims,
characterized in that a time delay is predefined so that
the charge or the discharge switch is switched to the ON
position according to the predefined time delay, the
5 predefined time delay being set to trigger when the
absolute value of the current equals or is greater than a
predefined current threshold.

11. Apparatus as according to any of the preceding
10 claims, characterized in that the current is not regulated
within a current band and exhibits gaps.

12. Method for charging a piezoelectric element in a
system, characterized in that a current of the system is
15 regulated as a function of a time characteristic and an
event characteristic to achieve an effective low average
current.

13. Method for charging or discharging a piezoelectric
20 element (1 and/or 11₁, 12₁, ... 1n₁) of a fuel injection
system, characterized in that a current of the fuel
injection system is regulated as a function of a time
characteristic and an event characteristic to achieve an
effective low absolute average current.

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14. Method as according to claims 11 or 12, characterized
in that the charge or discharge switch (3, 5) of the system
is switched from an OFF position to an ON position or from
the ON position to an OFF position, respectively to allow
30 or stop charging or discharging when an absolute value of
the current is respectively equal to or greater than or
less than the event characteristic which is a predefined

limit threshold current.

15. Method as according to claims 11, 12 or 13, characterized in that a charge or discharge switch (3, 5) of the system is switched from the OFF position to the ON position to allow charging or discharging at a predefined time of the time characteristic after the absolute value of the current is equal to or less than the event characteristic which is a predefined lower limit threshold current.

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16. Method as according to claims 11 or 12, characterized in that a square-wave signal of a certain frequency is used to switch a charge or discharge switch (3, 5) from an OFF position to an ON position to allow charging or discharging and characterized in that the charge or discharge switch (3, 5) is switched from the ON position to the OFF position when the absolute value of the current is equal to or greater than the event characteristic which is a predefined upper limit threshold current.

17. Method for charging or discharging a piezoelectric element (1 and/or 11₁, 12₁, ... 1n₁) of a fuel injection system, characterized in that a definition is made, prior to charging or discharging, for an absolute value of the current for charging or discharging the piezoelectric element (1 and/or 11₁, 12₁, ... 1n₁) as a function of a time characteristic of the fuel injection system.

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18. Application in particular eligible for use in a fuel injection system, the fuel injection system according to any of the foregoing claims, the fuel injection system

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preferably using a double acting control valve.